

Review

Transcendental meditation: A double-edged sword in epilepsy?

Ephraim Philip Lansky^{a,*}, Erik K. St. Louis^b

^a POB 9945, Haifa, Israel

^b Iowa Comprehensive Epilepsy Program, Department of Neurology, University of Iowa Hospital and Clinics, Iowa City, IA, USA

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Abstract

Transcendental Meditation (TM[®]) is derived from ancient yogic teachings. Both short- and long-term physiological correlates of TM[®] practice have been studied. EEG effects include increased alpha, theta, and gamma frequencies and increased coherence and synchrony. Neuronal hypersynchrony is also a cardinal feature of epilepsy, and subjective psychic symptoms, apnea, and myoclonic jerking are characteristic of both epileptic seizures and meditative states. Clinical vignettes have highlighted the potential risk of human kindling from repetitive meditation in persons practicing TM[®], but clinical studies of similar techniques suggest that meditation may also be a potential antiepileptic therapy. Future clinical studies of meditating subjects using video/EEG monitoring are warranted to determine whether behavioral phenomena have an underlying epileptic basis, and prospective clinical trials of TM[®] in subjects with well-delineated epilepsy syndromes are necessary to establish the safety of this technique and its potential efficacy for seizure reduction and improvement of quality of life.

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1. Introduction

Transcendental Meditation (TM[®]) is characterized by its principal exponent as a “simple and innocent technique,” deriving from both a

Science of Being [which] ... as does every other science, starts its investigation into the truth of existence from the gross, obvious level of life and later enters into the subtle regions of experience. The Science of Being, however, eventually transcends these subtle regions and arrives at the direct experience of the transcendental field of eternal Being [1].

and an

Art of Living: as the attention is drawn to consciously experience the subtler states of a thought during Transcendental Meditation, it is found that respiration

becomes greatly reduced in amplitude: the breathing becomes soft and refined [1].

TM[®], according to its certified teachers, is “not religion” and “not hypnotic induction,” though reference to Hindu gods during the *pūja* ceremony, required for “initiation” into its practice, and suggestions like “allowing the mantra to come on innocently by itself” during instruction are held otherwise by its critics [2,3]. With roots in ancient yogic teachings and the *Vedas*, TM[®] is taught via a multi-billion dollar operation known informally as “the Movement” and, formally, as “World Government” [4].

The practice of TM[®] consists of both core techniques accessible to novices and advanced techniques. During the core technique (after a “warmup” of about 30 seconds, just “allowing” all thoughts to come), the meditator then gently allows, preferentially, the individually assigned special secret sound, that is, the mantra (viz., name of some Hindu deity or function), to come over all other thoughts; then the “meditator” sits quietly for about 20 minutes, naturally allows the mantra to stop, sits quietly for another 2

* Corresponding author. Fax: +972 3 521 4728.

E-mail address: drlansky@netvision.net.il (E.P. Lansky).

minutes or so, then easily and naturally allows the eyes to open by themselves. The technique is prescribed two times a day, in the morning on arising and again in the afternoon, except during “residence courses,” during which there are as many as five or six “rounds” per day, consisting of the basic technique described above, sandwiched between several minutes of yogic postures (*asanas*), breathing exercises, specifically alternate nostril breathing (a type of *pranayama*), and videotaped lessons from the *Maharishi*. Supplemental “advanced techniques” practiced by some advanced TM[®] initiates (e.g., trained teachers or those practicing the technique longer than 5 years) include TM[®] Flying (*Sidhis* Program), in which “involuntary muscle contractions” are induced to allow the flyer a paroxysmal movement into the air from a sitting position.

The scientific basis¹ of the technique is stressed in the videotaped lessons and in the two introductory lectures offered prior to “initiation.” Reduction of stress, including oxidative stress [5*], is evidenced by changes in oxygen consumption [6*,7], blood flow [8*,9*], blood pressure [10*,11*,12], skeletal muscle tension [13], pituitary–adrenal [14,15*,16,17,18*,19*,20,21*,22*] and thyroid [23*] biochemistry, and other indices of parasympathetic/sympathetic activity [24,25*,26,27,28*] or, more accurately, *ergotropic/trophotropic* [29–31] tone.

The insistence of the TM[®] movement that TM[®] is a *unique* technique, that is, one that is fundamentally different from other meditation techniques, is only partly true. As previously mentioned, TM[®] draws from ancient yogic writings, a prime example of which is the *Yoga Sutras* of Patanjali [32]. This classic text describes the technique of *raja yoga*, in which exalted mental states such as *Samadhi* are achieved through the use of a mantra. Further, the text describes *siddhis*, spiritual powers, including the aforementioned assumed ability to achieve levitation, and additional powers, such as invisibility and “bilocation” (the ability to physically be in two places at the same time). The TM[®] *Sidhis* (sic) Program, an add-on to the core TM[®] product, purports to accept such powers as accruing from meditation practice, and specifically seeks to first develop the *siddhi* of levitation.

Nevertheless, despite these common roots and similarities, TM[®] is unique in that it involves a standardized instruction procedure and also claims a very large number of practitioners practicing their technique in a standardized manner, periodically “checked” by official “checkers” from the TM[®] movement. Therefore, even though the derivative psychophysiological states attained by TM[®] practitioners may be similar or identical to those achieved by practitio-

ners of other meditation systems (or the same core system expounded by other teachers), there is still considerable justification for focusing a review such as this one on TM[®]. This justification is based, briefly, on (1) the uniformity of TM[®] practice ensured by the highly organized TM[®] movement, and (2) the large amount of medical studies, originating from both within and without the TM[®] movement, already completed on this technique. But relatively little research has applied TM[®] specifically to epilepsy, whereas non-TM[®] meditation studies do show potential antiepileptic benefits, so studies of both TM[®] and non-TM[®] meditation systems, relative to epilepsy, are reviewed. Nonetheless, research findings derived from TM[®] versus other systems of meditation may not be entirely confluent.

2. TM[®]'s neurohumoral, neurochemical, and neurophysiological impact on cerebral function

Practice of TM[®] produces hormonal changes mimicking those of the inhibitory neurotransmitter γ -aminobutyric acid (GABA), including increased serum cortisol, growth hormone, and prolactin. TM[®] has been hypothesized to increase brain GABA by causing muscle relaxation and reducing insulin secretion and ketogenesis and ensuing ketosis-enhanced entry of glutamate, the amino acid substrate of GABA, into synaptosomes, providing more glutamate for conversion to GABA through the glutamate decarboxylase pathway [33]. TM[®]-induced GABAergic inhibitory neurotransmission, associated with ketogenesis, might thus underlie postulated antiepileptic effects [34,35].

Conversely, if the enzymatic conversion of GABA were not enhanced as postulated, glutamatergic facilitation with potential for excitatory neural transmission, excitotoxicity, and epileptogenesis could unfold. TM[®] has been found to enhance glutamate, the principal excitatory neurotransmitter in the brain, and serotonin, a neurotransmitter with mixed facilitating and inhibitory effects on seizure occurrence [36].

The EEG is an important element in the assessment of cerebral effects of TM[®]. EEG changes in meditation, in general and in TM[®] in particular, include increased coherence [37*,38*,39*,40*,41*,42*] (including possible “coherence” between two subjects [43*]), especially during apneic periods [6*,44*,45], and increased synchrony [46]. Other work has shown changes during deep sleep [47], such as increased theta–alpha activity simultaneous with delta [48*]. One study of 13 experienced meditators and matched controls demonstrated about a 1 cycle/second slower mean EEG frequency in the TM[®] group than in the controls [49]. Slowing of cortical auditory responses [50] and frontal theta bursts in 25% of 78 meditating subjects [51] have also been reported.

Gamma frequency activity has been described both for TM[®] and for other meditative practices [52,53]. Gamma-band activity in the frequency range 25–42 Hz localized over the frontoparietal regions was found to be increased from premeditation baseline in experienced compared with

¹ In Maharishi Universities, established for the purpose of promulgating the master's work, departments of science exist to prove the benefits of TM[®]. To quickly distinguish studies cited below that originate from such Maharishi University settings from those that originate in other academic settings, under References, the Maharishi University reference numbers are followed by an asterisk, as in [x*]. Those not obviously so associated are not so marked.

novice meditators, with further increased gamma activity over the entire scalp during and following meditation, suggesting that chronic meditation may induce not only short-term, but also long-term neural network alterations [47]. Provocatively, gamma frequency EEG activity has been observed both clinically and in animal models to correlate with epilepsy [54,55], exacerbated or precipitated in the case of primary generalized epilepsy by mental tasks (e.g., performing arithmetic) [56]. Although no clear evidence has yet proven that these neurochemical and neurophysiological manifestations of TM[®] are epileptogenic, predisposed practitioners of TM[®] could be at increased risk for developing epileptic seizures [57].

3. Suggestions of epileptic seizures provoked by meditation

TM[®] has been associated with symptoms and behavior resembling partial seizures, occurring both between meditative periods or in direct association with the meditative state itself. One survey of TM[®] meditators indicated significantly higher scores in religiosity and paranormal phenomena reporting (e.g., depersonalization, auditory hallucinations) than in nonmeditating controls [58]. It has been suggested that the TM[®] program, because of its fixed daily time schedule, may provide daily kindling analogous to that of rodent partial seizure experimental models [59]. However, many symptoms and much behavior during TM[®] practice could well be ascribed to simple visual and myoclonic hypnagogic phenomena [60].

Epileptiform EEG alterations have been reported in two single cases of persons practicing TM[®] and/or the TM[®] Sidhis Program. (The term *siddhis* refers to discrete “spiritual powers” that allegedly ensue from these more advanced practices. Such powers are said to include invisibility and levitation.) In one case, 10 different experienced practitioners (i.e., teachers) of TM[®] underwent electroencephalography during meditation, and one was felt to demonstrate a partial seizure of temporal lobe origin after 19 minutes of meditation [58]. However, inspection of this electroencephalographic event by one of the authors, a board-certified clinical electroencephalographer and neurophysiologist (E.K.S.), demonstrated rhythmic activity that could have represented electrode artifact (as only six recording electrodes over each midtemporal, frontal, and occipital region were used), and these were likely referenced to each other from the authors’ description of the montage; these technical limitations are inconsistent with minimum clinical technical standards for EEG recording [59]. Review of a second case in this same article that was felt to represent activation of interictal epileptiform spikes during meditation was also instead more consistent with mere muscle artifact.

A separate second case of possible seizure activation during meditation noted occasional brief bursts of 3-Hz spike-wave complexes during meditation in a person with no prior history of epilepsy. Unfortunately, this report did not specify whether clinical symptoms or signs were

evident during these discharges or if there was a family history of epilepsy, and no segments of these EEG discharges were published, so the reported EEG abnormalities cannot be further scrutinized or confirmed as legitimate epileptiform discharges. These authors also claimed that increased seizures were frequent side effects during TM[®] that prompted persons with epilepsy to drop out of meditation courses. Apparently, in their experience, TM[®] teachers generally felt that meditation-provoked seizures were a good sign indicative of discharged stress, and would typically recommend more meditation in such instances [61]. Although these cases are far from conclusive in demonstrating an epileptogenic effect of TM[®], they do suggest the need for future safety studies using video/EEG recording with standard 10–20 electrode placement, adequate montages for interpretation, and interpretation by a qualified electroencephalographer.

4. Evidence for TM[®] as a potential antiepileptic therapy

In one study, 15 subjects (aged 20–30, 8 men and 7 women) with intractable epilepsy on three or more baseline antiepileptic drugs practiced TM[®] 1 hour daily, and received “energy healing” from a Reiki practitioner, where the healer meditates, reaches a trancelike state, and transfers his “life force” (claimed to represent a low level of electromagnetic force) by touching the subject with his hand for three treatments a week. The experimental period was 3 months and was defined as both the time during meditation and the time between those periods. Seizure frequency was assessed and compared with a retrospective baseline, and serum blood levels of various electrolytes, hormones, and amino acids were calculated before and after the trial. There was a significant decrease in seizure frequency in each of the subjects in the experimental group, with some subjects benefiting from up to 75% seizure reduction, and serum magnesium increased relative to baseline and control values, suggesting a possible mechanism for the antiepileptic effects observed [62]. Unfortunately, this particular study did not distinguish the effect of TM[®] from the effects of Reiki treatments. But, in two earlier studies, TM[®] was purportedly used successfully in the treatment of patients with epilepsy [63*,64].

A previous review summarized evidence that yoga practices including *asana* (postures), *pranayama* (breathing exercises), and *dyana* (meditation/concentration), but not TM[®] specifically, may have beneficial effects in decreasing seizure frequency. The author concluded that a randomized clinical trial was necessary [65], and a colleague suggested a protocol for future investigations [66].

Two studies were also made of 32 subjects with idiopathic epilepsy practicing another system of meditation known as Sahaja yoga meditation over a 6-month period in three groups: those practicing the correct technique under supervision, those practicing a sham technique involving practices that were not the correct ones, and nonpracticing negative controls. Persons practicing the

correct technique exhibited both decreased frequency of seizures [67] and improvements in visual contrast sensitivity and midlatency auditory evoked responses (MLRs) [68].

5. Discussion: The middle ground perspective

Several electroclinical correlates of TM[®] and epilepsy overlap. Clinical characteristics accompanying TM[®] such as psychic symptoms, myoclonus, and apnea may also be seen in epilepsy [69,70]. Although the EEG coherence and synchrony accompanying TM[®] practice have been ascribed to a “higher state of consciousness” [71*], neural hypersynchrony is also a defining characteristic of epilepsy. Differentiating the presumed physiological hypersynchrony of TM[®] from the pathological hypersynchrony of epilepsy [72,73,74,75] is challenging, yet, in our opinion, the similarity does warrant concern for potential epileptogenesis in TM[®] practitioners.

TM[®] as a potential provocateur of epilepsy is unproven, as the literature attempting to establish such a connection is of either a theoretical or anecdotal nature. Although theoretical concern for exacerbation of epilepsy by TM[®] appears largely cogent, and anecdotes of supposed seizure provocation are alarming, several physicians and researchers with long-term experience in practicing or teaching TM[®] stress their unequivocal doubt that TM[®] causes or exacerbates epilepsy [76*,77*,78*,79*]. However, as published rebuttals of theories positing a relationship between meditation and epilepsy have stemmed largely from meditation proponents, balanced skepticism toward meditators’ opinions (given their inherent biases and conflicts of interest) seems equally appropriate to the doubt they have cast on a relationship, until prospective observational research establishing meditation’s safety exists.

There are two ways in which meditation could theoretically provoke seizures. Meditation could provoke acute seizures in susceptible individuals during the meditative state alone, or meditation could lead to longitudinal kindling that could kindle the brain to provoke development of epilepsy, leading to seizure occurrence between meditative sessions. To ensure the acute and long-term safety of meditation, further prospective study is necessary. Well-designed prospective video/EEG monitoring studies of TM[®] – meditating volunteers and patients with epilepsy must be conducted by investigators with appropriate training in clinical neurophysiology, to determine whether manifestations that accompany TM[®] practice coincide with epileptiform abnormalities and to ensure that TM[®] is safe. Additionally, longitudinal prospective follow-up studies of novice and experienced meditators to survey for symptoms of epileptic seizure occurrence would be necessary to ensure that long-term practice of TM[®] does not lead to development of epilepsy.

The evidence that TM[®] possesses either therapeutic potential for epilepsy or epileptogenic effects, although provocative, is soft. That TM[®] might have value as an antiepi-

leptic therapy would not be particularly surprising, because other behavioral and partially behavioral techniques, like aromatherapy, with or without hypnosis [80], and biofeedback based on EEG tracings [81], may improve epileptic seizure frequency (though curiously, hypnosis has also been reported to induce psychogenic nonepileptic spells, i.e., pseudoseizures [82,83]). However, despite the heuristic potential of TM[®] (or related systems of meditation) for the treatment of epilepsy, it is critical to more clearly delineate the potential for TM[®] and its congeners to exacerbate or precipitate epilepsy. Several pharmacological [84] and behavioral interventions [85,86] that cause physical or psychological disturbances at high doses or treatment intensities effectively treat those same conditions at low doses or more moderate intensity. TM[®] may have just such a therapeutic window of benefit for epilepsy and other health conditions, outside of which TM[®] could lead to paradoxical iatrogenic adverse effects rather than intended efficacy.

TM[®] has not yet been studied as a potential epilepsy treatment, although other comparable systems of meditation have. Because proponents of TM[®] specifically insist that TM[®] is dissimilar from other systems of meditation, the findings on meditation as therapy for epilepsy do not lend evidence for therapeutic application (or safety) of TM[®] in epilepsy. Systematic, controlled clinical trials are necessary to evaluate both the safety and therapeutic potential of TM[®] for epileptic patients. These two objectives and potential trial designs are briefly considered next.

Future studies of meditation and epilepsy would be best designed and conducted with four complementary goals. First, to determine if meditation is associated with development of epilepsy, a large, population-based, cross-sectional retrospective cohort study should be performed. Second, to address whether meditation provokes *de novo* interictal epileptiform activity or ictal seizures acutely or chronically via kindling of the healthy, nonepileptic brain, a prospective study of novice meditators without a history of epilepsy, using serial video/EEG recordings during meditation and sham meditation sessions, should be carried out. Third, to explore whether meditative behavioral phenomena in experienced/expert meditators without known epilepsy are in actuality subtle simple partial seizures, ictal video/EEG recordings using true temporal or sphenoidal electrode placements are necessary. Fourth and last, to determine whether meditation is a safe and effective treatment for improvement of clinical seizure burden in known patients with epilepsy, large, prospective, double-blind, randomized clinical trials comparing the effects of meditation with control sham techniques in different epilepsy syndromes, including primary idiopathic generalized epilepsy, mesial temporal lobe epilepsy, and other partial epilepsy syndromes, should be mounted. Although designing a clinical study involving meditation would be somewhat logistically difficult, concealing randomization between sham and meditation groups and blinding physician raters and EEG interpreters should limit bias and yield interpretable results.

6. Conclusion

Transcendental Meditation (TM®) is a behavioral practice with physiological and neurophysiological sequelae that could exacerbate or, alternatively, treat epilepsy. Well-designed retrospective and prospective clinical investigations, including population-based, epidemiological studies of meditation and epilepsy and clinical trials in novices, experienced meditators, and subjects with epilepsy, could help answer the persisting questions of whether meditation kindles human brain or precipitates epileptic seizures in susceptible individuals, and whether TM® holds promise as another nonpharmacological antiepileptic therapy. We call for unbiased research rather than conjecture and personal opinion on these important public health questions. TM®, like other interventions producing potent physiological effects, should be treated with respect and caution in individuals for whom such practices may be contraindicated.

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